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Heft et al.

[11] **4,431,877**

[45] **Feb. 14, 1984**

[54] **THERMAL SHIELD FOR CIRCUIT BREAKER OPERATING SPRING**

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[73] Assignee: **General Electric Company**, New York, N.Y.

[21] Appl. No.: **353,449**

[22] Filed: **Mar. 1, 1982**

[51] **Int. Cl.**[3] **H01H 33/02**

[52] **U.S. Cl.** ..... **200/144 R**; 200/304

[58] **Field of Search** ..... 200/147 R, 144 R, 304, 200/305

[56] **References Cited**

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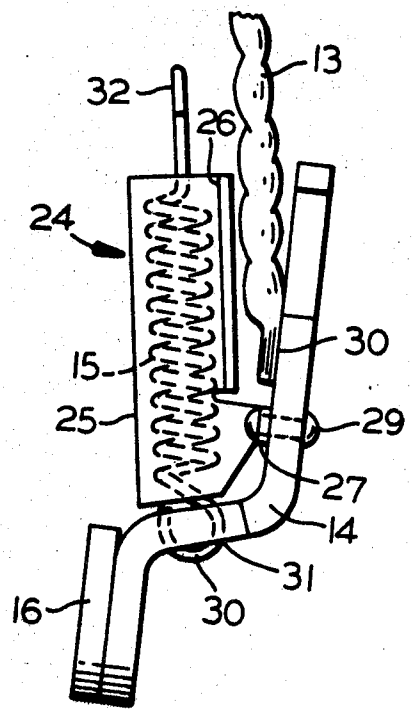
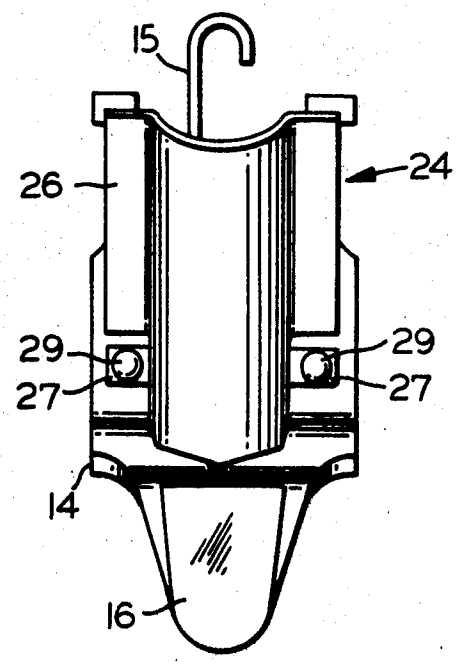
Attorney, Agent, or Firm—Richard A. Menelly; Walter C. Bernkopf; Fred Jacob

[57] **ABSTRACT**

A thermal shield is employed with a circuit breaker operating spring to protect the spring from thermal degradation during contact arcing. One embodiment includes an ablative plastic coating on the outer surface of the shield to promote arc quenching.

10 Claims, 7 Drawing Figures





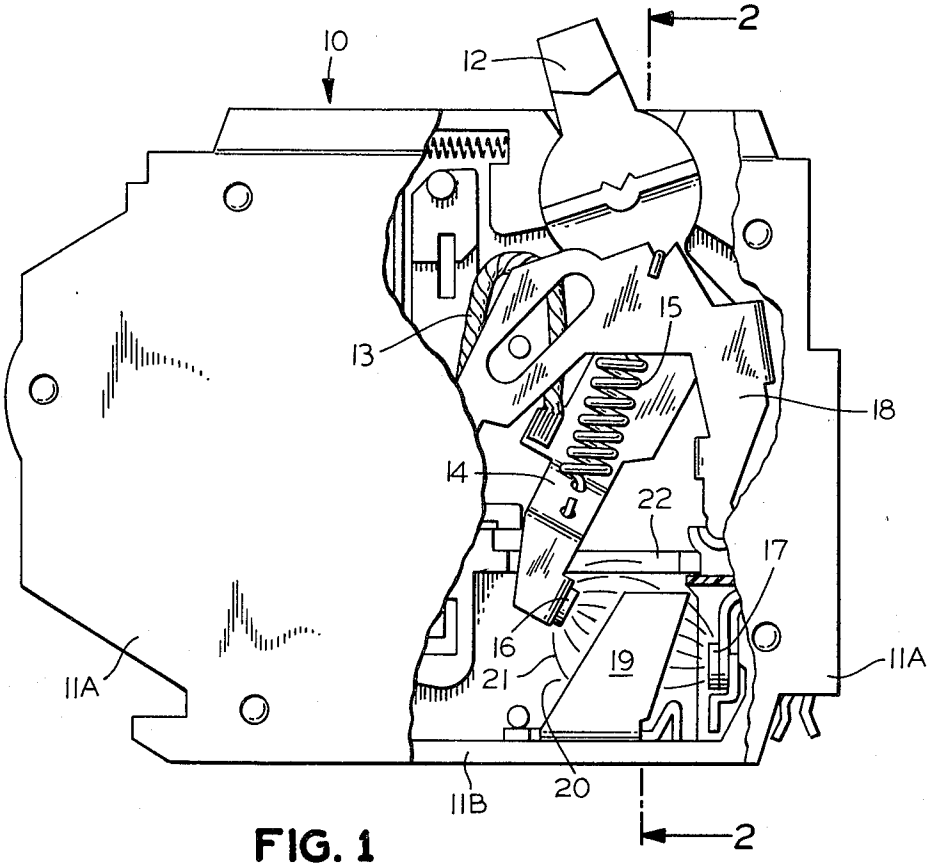

10
12
2
13
15
18
14
22
17
16
19
21
11A
11A
11B
20
2

FIG. 1

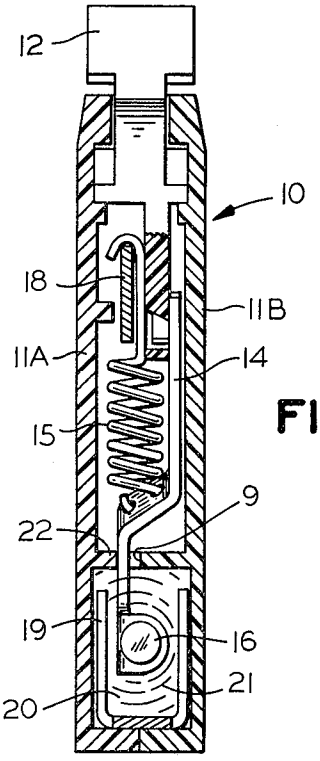

12
10
18
11B
11A
14
15
9
22
19
16
21
20

FIG. 2

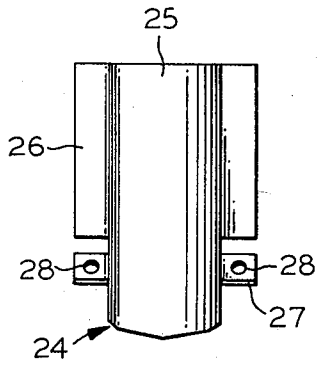


FIG. 3

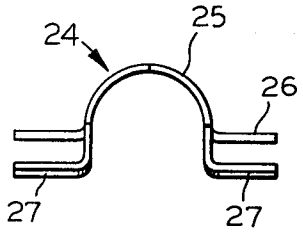


FIG. 4

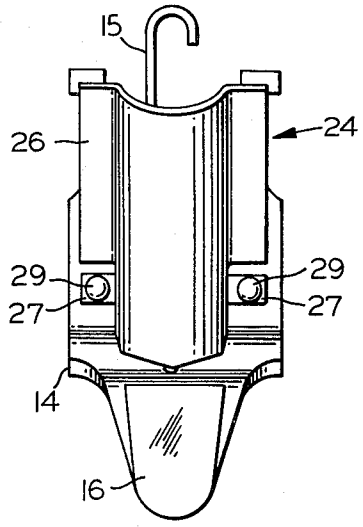


FIG. 5

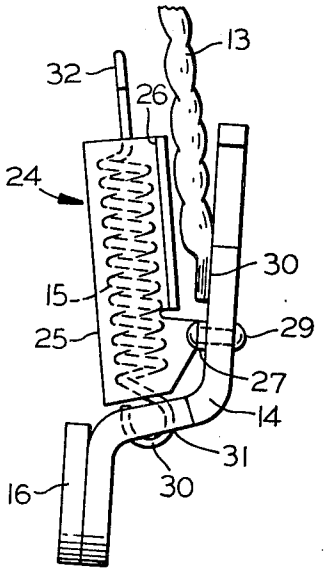


FIG. 6

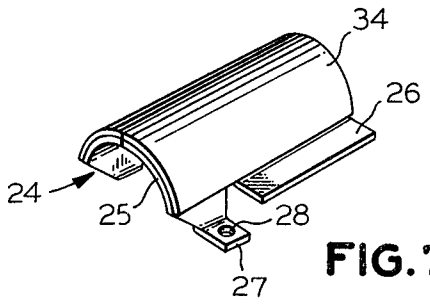


FIG. 7

THERMAL SHIELD FOR CIRCUIT BREAKER OPERATING SPRING

BACKGROUND OF THE INVENTION

Repeated exposure of a circuit breaker operating spring to the temperatures attained during contact arcing can cause thermal degradation of the spring which changes the operating characteristics. U.S. Pat. No. 4,011,420, entitled, "Molded Case Circuit Breaker With Improved Interrupting Capacity" describes a molded case circuit breaker which includes a barrier between the arcing chamber and the operating spring along with an arc runner to assist in controlling the extinction of the arc developed incident to an interruption. This patent is incorporated herein for purposes of reference. It has been discovered that under repeated arcing conditions, some of the gases generated during contact arcing seep through the clearance provided in the barrier for contact arm motion, and carry some of the heat generated by the arc up to the operating spring. Under extreme arcing conditions, the operating spring characteristics may become altered thereby effecting the breaker tripping mechanism.

A further prior art attempt to reduce thermal degradation of the main operating spring consisted of a moveable shutter attached to the contact arm and extending over the arcing chamber. Movement of the contact arm causes the shutter to follow and provide a baffle between the arcing chamber and the operating mechanism during contact separation.

The purpose of this invention is to provide means for protecting the circuit breaker operating spring from the high temperature gases evolved during contact arcing.

SUMMARY OF THE INVENTION

The invention comprises the provision of a heat shield partially around a circuit breaker operating spring. The heat shield is secured to the circuit breaker moveable contact arm. One embodiment consists of a semi-cylindrical metal shield arranged concentrically around the operating spring. A further embodiment employs an ablative plastic coating on the exterior surface of the shield to evolve an arc quenching gas when contacted by the effluent arc gases. The ablated gases also cool the shield and, hence, protect the spring from thermal degradation. Another embodiment consists of a thermal shield fabricated from an ablative plastic material which provides both a thermal barrier as well as a quenching gas source.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a molded case circuit breaker casing with part of the breaker mechanism exposed;

FIG. 2 is a section of the circuit breaker depicted in FIG. 1 through the plane 2—2;

FIG. 3 is a plan view of the operating spring heat shield according to the invention;

FIG. 4 is an end view of the shield depicted in FIG. 3;

FIG. 5 is a plan view of a contact arm including the operating spring and thermal heat shield of the instant invention;

FIG. 6 is a side view of the contact arm shown in FIG. 5; and

FIG. 7 is a top perspective view of the heat shield according to the invention including an ablative plastic coating.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A detailed description of a molded case circuit breaker is contained within the aforementioned U.S. patent. FIG. 1 shows a cutaway portion of a circuit breaker **10** similar to that disclosed within the aforementioned patent for which reference is made for a more complete explanation of the structure and operation of the components to be described herein. Circuit breaker **10** consists of a cover **11A**, and base **11B** made of a moldable plastic material and includes an on/off handle **12** extending through the cover for the purpose of switching the circuit breaker on and off as well as for providing a resetting function to the breaker. A copper braid **13** connects electric power to breaker contact arm **14** which carries the circuit breaker operating spring **15**. At one end of contact arm **14**, there is affixed a moveable contact **16** which cooperates with a fixed contact **17** for the purpose of completing the electrical circuit through the breaker. A cradle **18** is hingeably connected with contact arm **14** and an arc chute **19** is partially interposed between fixed and moveable contacts **16, 17** to provide a means for containing arc **21** which occurs when contacts **16, 17** become rapidly disengaged. An arc chamber **20** is provided beneath contacts **16, 17** in order to allow for the expansion of arc **21**. A barrier **22** extends between cover **11A** and base **11B** to provide a means for containing arc **21** within arc chamber **20**. In order to allow for the motion of contact arm **14** when contacts **16, 17** are brought in and out of engagement, a clearance **9**, shown in FIG. **2**, is defined within barrier **22**. Clearance **9** then allows gases which become evolved by the heat generated by arc **21** to transmit up to the vicinity of contact arm **14** and operating spring **15**.

FIG. **3** contains a thermal shield **24** for use with the operating spring **15** shown in FIGS. **1** and **2**. A semi-cylindrical body or closure **25** fabricated from a single piece of metal contains a base portion **26** and a pair of depending tabs **27**. Base **26** provides additional shielding surface while tabs **27**, which include holes **28**, are used for attaching shield **24** to contact arm **14**. Shield **24** is shown in FIG. **4** with body member **25**, base **26** and tabs **27**. Base **26** extends above tab **27** to provide operative clearance for operating spring **15**.

FIG. **5** shows the arrangement of shield **24** partially encompassing operating spring **15** with shield tabs **27** fastened to contact arm **14** by means of rivets **29**. Body **25** can also be directly attached to contact arm **14** by welding, if so desired. The offset relation between base **26** and tabs **27** is shown in FIG. **6** with tabs **27** held flush against the surface of contact arm **14** by means of rivets **29** and with base **26** and body **25** cantilevered from contact arm **14** at the point of contact with tabs **27**. This cantilevered arrangement of shield **24** is necessitated by the change in length of operating spring **15** when contact arm **14** is pivoted between the open, tripped and closed positions of contacts **16** and **17**. Braid **13** is attached to one side of contact arm **14** by means of a weld **30** whereas operating spring **15** is generally situated axially along the center line of contact arm **14**. Operating spring **15** is attached to contact arm **14** by hooking spring end **30** within groove **31** as shown in FIG. **6**. The opposite end **32** of spring **15** is attached to cradle **18** as

shown in FIG. 2. When shield **24** is employed within the circuit breaker described in FIGS. **1** and **2**, prolonged arcing can occur without deleteriously effecting operating spring **15**. An additional benefit is achieved by employing an ablative coating or cover **31** on the exterior of body **25** as shown in FIG. **7**. When an ablative material, such as "Delrin", which is a trademark for an acetal resin formulation becomes heated by contact with the gases generated in the vicinity of arc **21** as shown in FIGS. **1** and **2**, the Delrin material abates, giving off a monolayer of compositional gases, including hydrogen, which rapidly cool the surface of body member **25** and decreases the amount of heat reaching spring **15**. The gas generated during ablation also assists in quenching arc **21** as described, for example, in U.S. Pat. No. 3,632,926, assigned to the common assignee of the instant invention, and which is incorporated herein for purposes of reference. Other ablative plastic materials which are commercially available may also be employed. In some applications, the entire shield **24** can be stamped, pressed or molded from the ablative material itself to provide both the shielding and ablative cooling function. When the shield **24** depicted in FIG. **3**, for example, is made from an ablative plastic material, holes **28** could be dispensed with and shield **24** can be fastened to contact arm **14** by means of a meltable adhesive such as a silicone resin or by means of ultrasonic welding.

Although the thermal shield of the invention is described for use with a one-half inch wide circuit breaker as generally shown in FIGS. **1** and **2**, this is by way of example only. The inventive shield finds immediate application in circuit breakers having a width greater than one-half inch and having no arc chamber barrier whatsoever.

We claim:

1. A thermal heat shield for molded case circuit breakers comprising:

a body member at least partially encompassing a circuit breaker operating spring; and

means for attaching said body member to a circuit breaker moveable contact arm, said body member being concentrically arranged on said spring.

2. A thermal heat shield for molded case circuit breakers comprising:

a body member at least partially encompassing a circuit breaker operating spring; and

means for attaching said body member to a circuit breaker moveable contact arm, said attaching means comprising at least one tab depending from said body member and defining means for inserting a fastening device.

3. The thermal shield of claim **1** including a cover of an ablative material on the surface of said body for evolving gas upon the occurrence of an arc within said circuit breaker.

4. The thermal shield of claim **3** wherein the ablative coating comprises an acetal resin.

5. The thermal shield of claim **2** further including a base on both sides of said body member for providing additional shielding surface to said spring, said base extending above said tabs.

6. The thermal shield of claim **2** wherein said tabs are attached to said contact arm by means of rivets.

7. A thermal heat shield for molded case circuit breakers comprising:

a body member at least partially encompassing a circuit breaker operating spring; and

means for attaching said body member to a circuit breaker moveable contact arm, said body being attached to said contact arm by means of welding.

8. The thermal shield of claim **5** wherein said body member and said base are cantilevered from said contact arm.

9. A thermal heat shield for molded case circuit breakers comprising:

a contact arm supporting a moveable contact member within a circuit breaker casing;

an operating spring carried by said arm for moving said moveable contact in and out of communication with a fixed contact; and

means formed integrally with said contact arm for shielding said operating spring during separation of said fixed and moveable contacts.

10. A molded case circuit breaker comprising:

an insulative housing supporting a moveable contact arm having a contact at one end and an input and output terminals;

a fixed contact for communicating with said moveable contact to provide electrical continuity between said terminals;

an operating spring for moving said moveable contact into said communication with said fixed contact to provide said electrical continuity and for moving said moveable contact away from said fixed contact to provide circuit interruption between said terminals; and

shield means proximate said operating spring to protect said operating spring from thermal degradation by arcing between said fixed and moveable contacts during said circuit interruption.

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